

Biodegradable Hydraulic Fluids High Performance Environmentally Safe

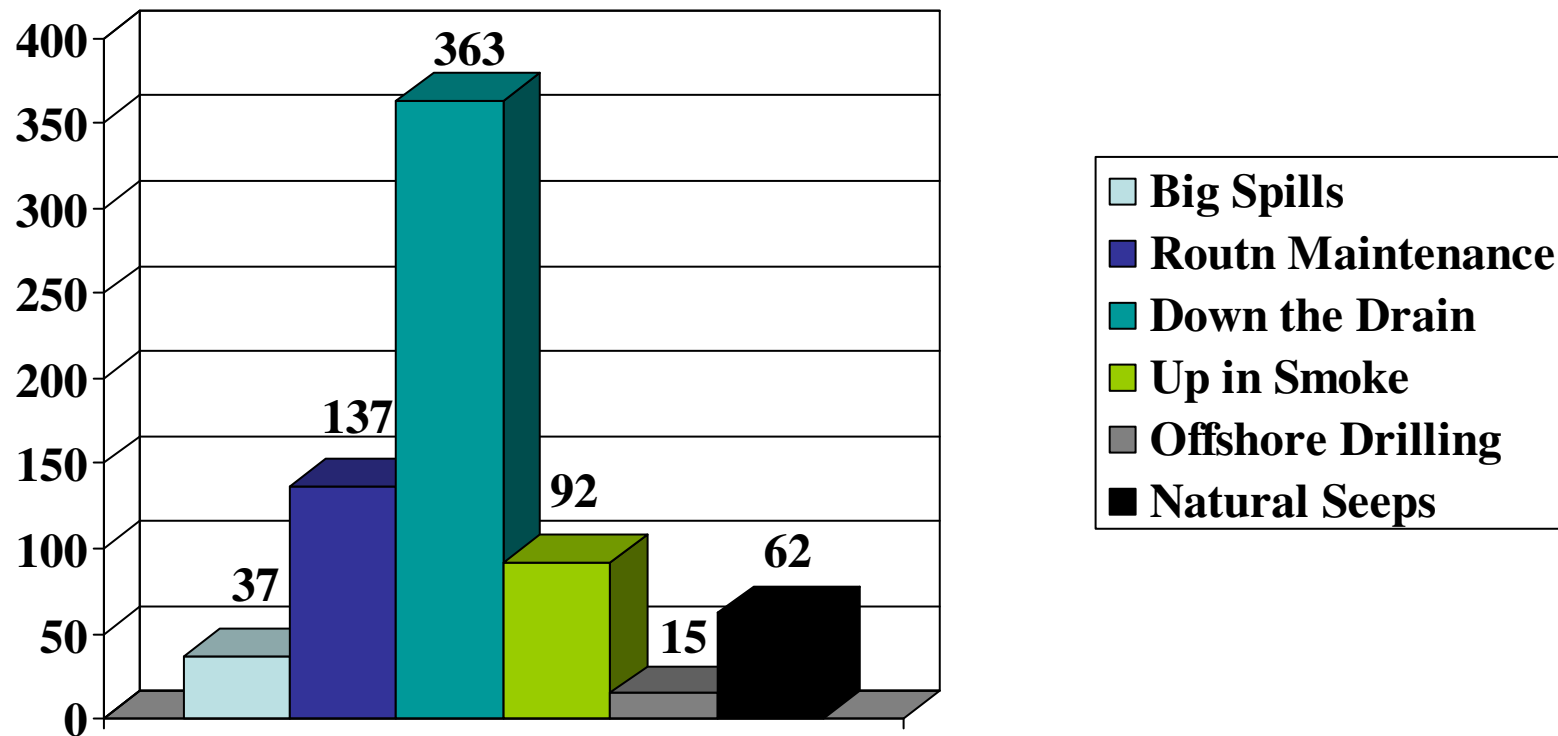


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www.terresolve.com



Oil Into The Ocean

706 Millions Of Gallons Per Year*



*Source: NOAA

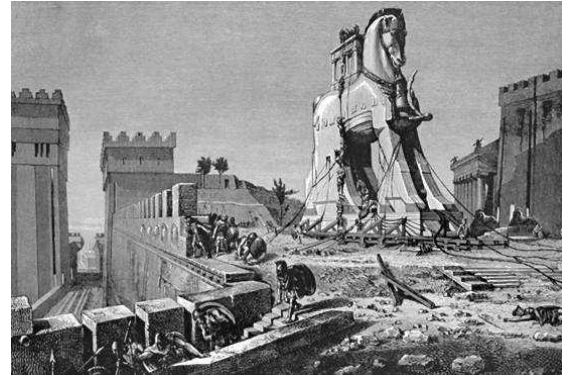
Terresolve Fluids

- Are ***readily*** biodegradable
- Are virtually non-toxic
- Do NOT Sheen
- Do NOT cause sludge or emulsion
- Improve system performance
- Have excellent durability
- Are compatible with petroleum fluids

Biobased Lubricants are NOT New



35,000 BCE



500 BCE



AD 116



1996



Bio-Based,
Biodegradable Lubricants

**BUT... We Know A Lot of
Biodegradable Oils Didn't Work
Many Still Don't!**

Why Did They Fail?



Lubricant = Additives + Petroleum Oil

Bio Lubricant = Additives + Vegetable Oil

Great Idea

Didn't Work

These not your father's biofluids!

- Improved Formulation
 - Specifically designed for specific equipment
 - Extensive Testing
- Improved Application
 - The right product for the right application
- OEM Approved
 - Years of field proven performance

I can't speak for ALL biofluids

But I can tell you about the ones that I know



Who Else Uses Biofluids?



Marine Construction



Clean Energy



Utilities



Waste Hauling



Snow Throwing

Who's Using It?

- 1996 – R&R Golf, Ohio Industrial, Mohawk C.C
- 1997 – Various Country Clubs in North East
- 1998 – Virginia Forestry,
- 1999 – Ohio DNR, Yosemite NP
- 2000 – Commonwealth of Ma, Kings County
- 2001 – NYS DOT, PA DOT, US Navy, Crater Lake
- 2002 – South Florida Water, Great Smokey Mountains, Denali N.P., Douglas County Roads
- 2003 – State of Vermont, Mount Raineer, Northeast Utilities

What are Environmentally Safe Fluids?

Glycol?

Food Grade?

Ester?

Readily
Biodegradable?

Environmentally
Friendly?

Synthetic?

Inherently
Biodegradable?



Clean?

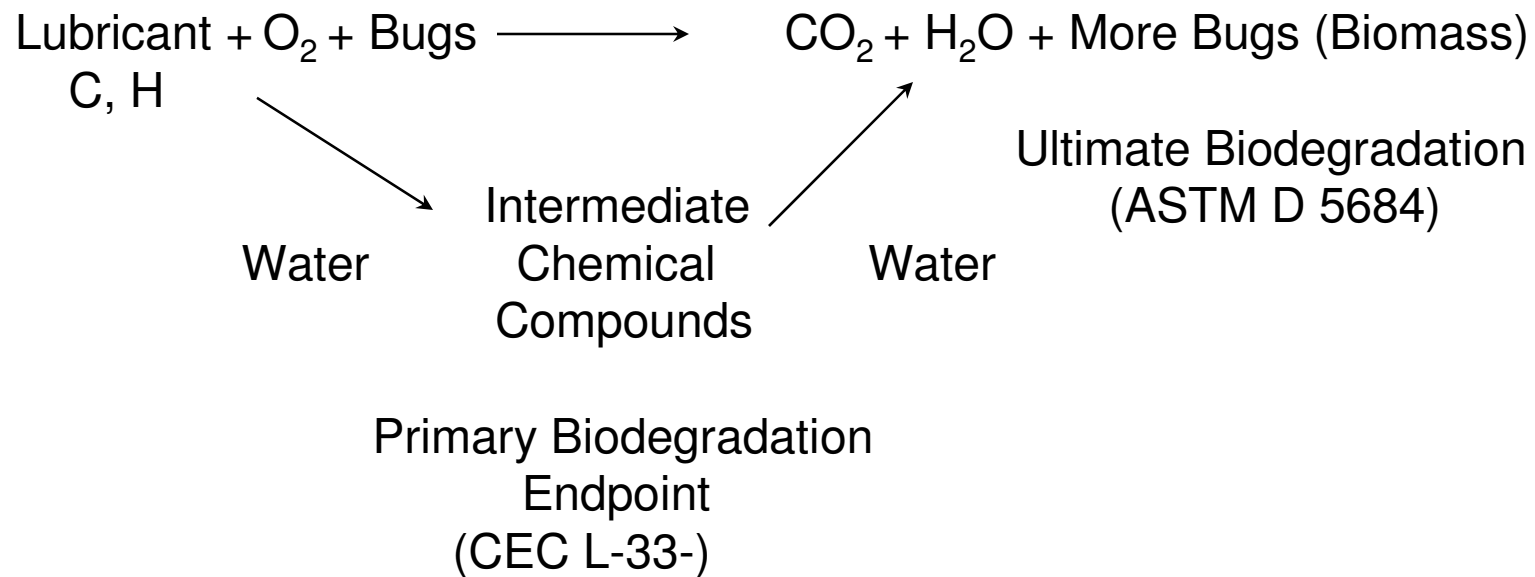
Sheen?



Vegetable?
Bio-based
Biodegradable Lubricants

Primary Preliminary Vs. Ultimate Final Biodegradation

Simplified Biodegradation Reaction:

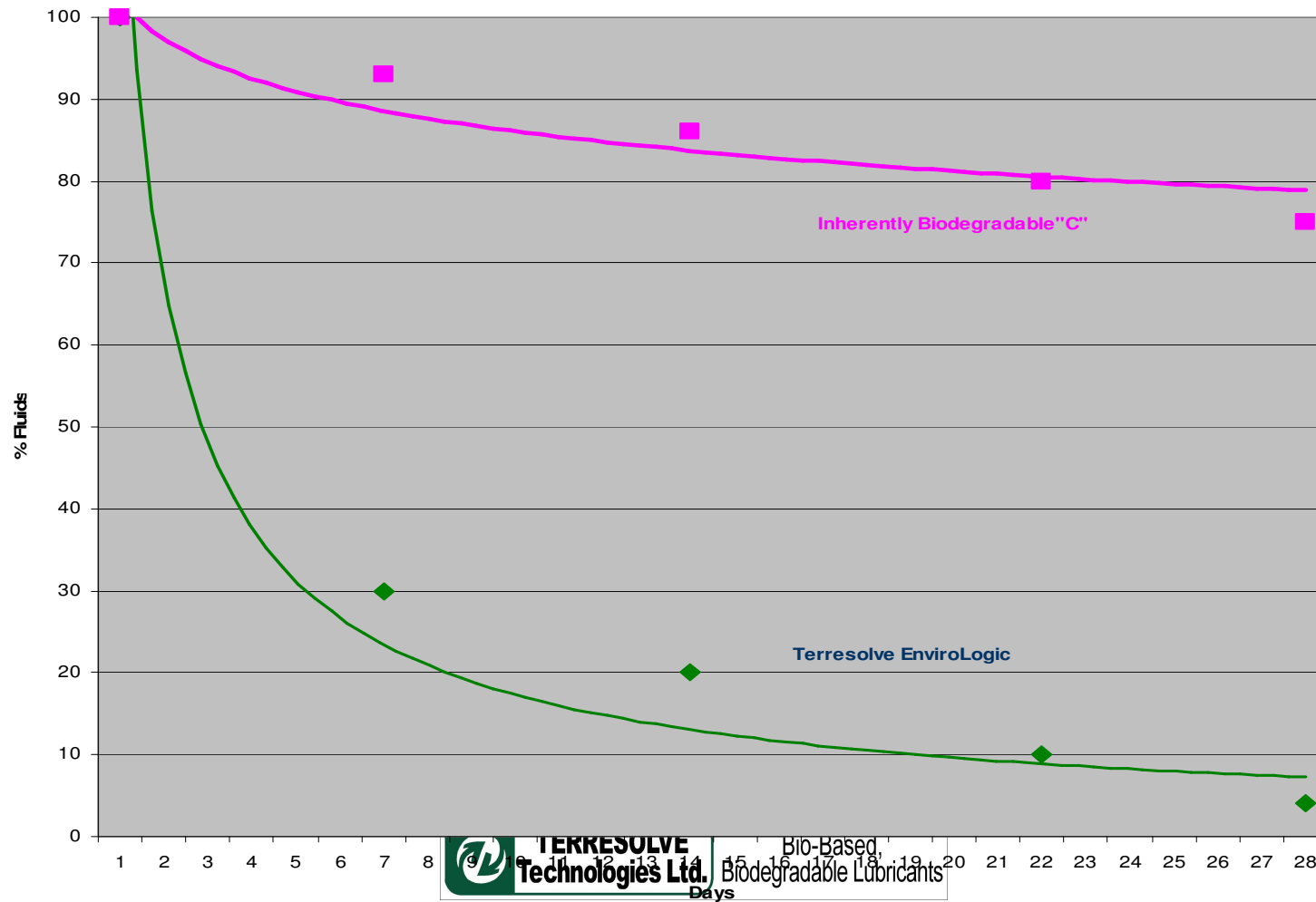


Types of Biodegradability

- ***Readily*** Biodegradable Hydraulic Fluids Break Down Over 90% in 28 Days
- ***Inherently*** Biodegradable Products Break Down... **Someday** ... after fines, cleanup, downtime and environmental destruction!

Readily vs. Inherently

Biodegradability Vs. Time



ASTM 5864 Biodegradability

Designation	Test method	% Degradation	Days	EnviroLogic 100	EnviroLogic 100H	EnviroLogi c 3000	EnviroLogi c 200
Pw1	Ultimate	60	28	70	>65	>65	>65
Pw2	Ultimate	60	84	100	100	100	100
Pw3	Ultimate	40	84				
Pw4	Ultimate	<40	84				
PwC	Primary	80	21	94	>90	>90	>90
Pw5	Primary	<80	21				

Hydraulic systems (ISO 6743/4)

Automatic transmissions	HA
Fire resistant fluids	HF
Oil in water emulsions (soluble oils)	HFAE
Chemical solutions in water	HFAS
Water in oil emulsions (invert emulsions)	HFB
Water polymer solutions (water glycol)	HFC
Synthetic fluids containing no water	HFD
Phosphate ester	HFDR
Chlorinated hydrocarbons	HFDS
Mixtures of HFDR and HFDS fluids	HFDT
Other compositions	HFDU
Hydraulic-slide way	HG
Refined mineral oil	HH
R&O	HL
Antiwear	HM
Couplers & converters	HN
High VI R&O	HR
High VI AW	HV
Synthetic w/o fire resist	HS

Types of Environmental Oils

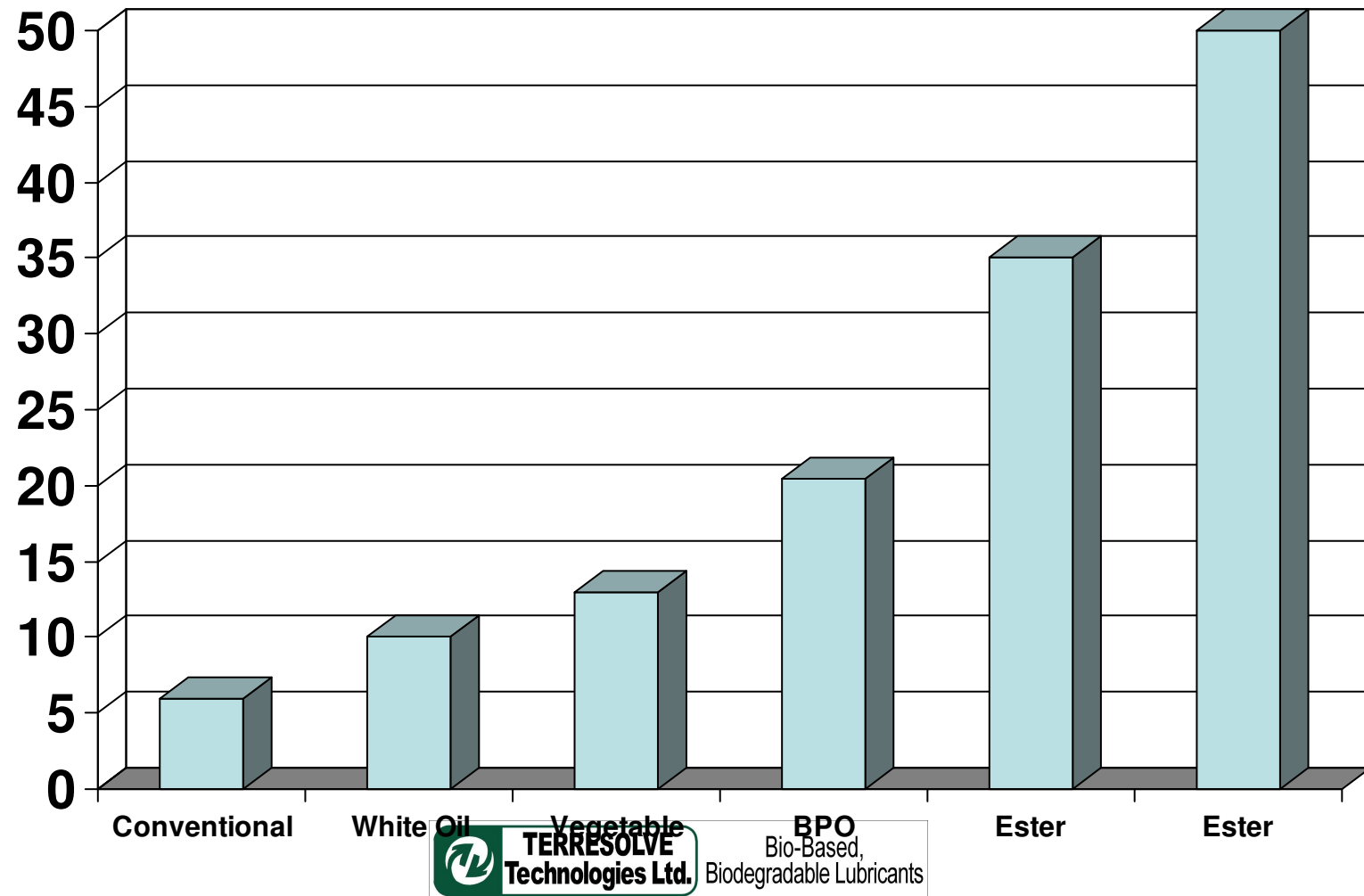
ISO 6743/4

None	Inherently NOT BIOGRADABLE
HETG	Vegetable
HEPG	PAG
HEES	ESTER
HEPR	PAO and related product

Environmental Performance of Various Classes of Fluids

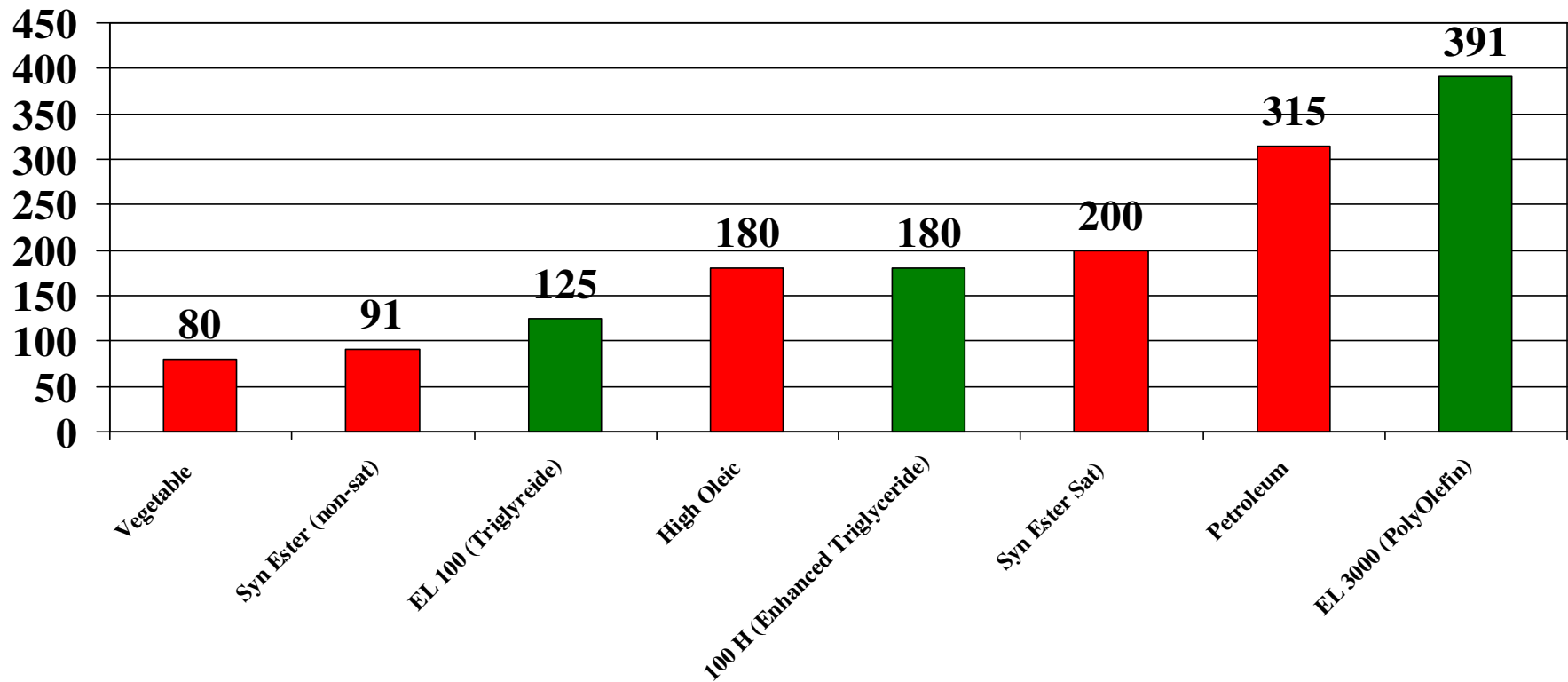
Type	Base Fluid	Class	Biodegradation Time	Toxicity	Typical Performance	Seal & Hose Compatibility	Water Tolerance
Inherently Biodegradable	Petroleum	NONE	Years	Varies	Good	Excellent	Good
Triglyceride (Vegetable)	Vegetable	HETG	Days	Low	Varies	Mixed	Medium
Poly glycol (PAG)	Glycol	HEPG	Years	High	Weak	Very Poor	Very Weak
Synthetic Ester	Synthetic	HEES	Days	Low	Mixed	Very Poor	Very Weak
BioPolyOlefin	Synthetic	HEPR	Days	Low	Excellent	Excellent	Excellent

Cost per Gallon



Life of the Fluid

Rotary Bomb Oxidation Test



Terresolve Environmentally Safe Products



Biodegradable Products

Include:

- ✓ Antiwear Hydraulic Fluid
- ✓ Sealing Fluid
- ✓ Gear Oil
- ✓ Grease
- ✓ Bio-diesel Fuel
- ✓ Cylinder Lubricant
- ✓ Bar, Chain, Cable, Wire Rope Oil
- ✓ Marine Lubes
- ✓ Flushing Oil
- ✓ Universal Hydraulic Transmission Fluid
- ✓ Engine Oil

Markets

- Turf
- Forestry
- Utilities
- Hydroelectric
- Offshore Drilling and Exploration
- National and State Parks
- Amusements (theme park and carnival)
- Marine Transportation
- Directional Drilling

EnviroLogic® 440

Air-cooled Two-cycle Oil

- Application:
- String trimmers, chainsaws, golf carts, blowers
- Key Benefit:
- Rapid biodegradation and low (no) toxicity will not adversely affect plants, animals, or water where unburned oil is deposited on grass and in water.
- Approvals:
- • API (U.S.): TC
- • JASO (Japanese): FC
- • ISO (Global): GD.
- Field & OEM testing:
- Stihl, Tecumseh, Tanaka



EnviroLogic® 268

Bar & Chain Oil

- Key Application:
- Chainsaws, chain driven equipment
- Key Benefit:
- Reduced “sling off” will result in less oil on the ground and more on the chain
- Biodegradable and non-toxic will result in negligible negative environmental impact.



EnviroLogic® 802A

Biodegradable, NLGI # 2 Grease

Application:

Environmentally sensitive areas - Does not kill the plants or animals

Automotive - GC-LB (highest performance rating) chassis, wheel bearing

Marine - Biodegradable, will not hurt fish

Wet environment - High water wash-off tolerance

Key Benefits:

Excellent extreme pressure - Protects equipment better

Excellent antiwear protection

High dropping point - Stay in place at high temperatures

Compatible with petroleum and synthetic grease- No change-over concerns

Approvals:

NLGI GC-LB



EnviroLogic® 39 – 39 A

General Purpose Lubricating and Preservative Oil

- Application:
- Various. Used as a safe replacement for 3-in-1™, Liquid Wrench™ and the like.
- Key Benefit:
- Biodegradable and non-toxic so is safe for people, plants and animals
- Outstanding corrosion protection (10 times the commercial equivalent) and will protect equipment longer.
- Field testing:
- Frozen Bolt Test
- Iron Wedge Test
- Bolt Test
- Industry Tests
- Humidity Cabinet
- Salt Fog ASTM B 117



AquaLogic® 460

Water-cooled, Two cycle Engine Oil

- Application:
- Outboard motor boats, personal water craft (jet skis) snowmobile
- Key Benefits:
- Rapid biodegradation and low (no) toxicity; will not adversely effect water life
- Reduced hydrocarbon emission
- Enhanced performance; reduced wear
- Approvals:
- National Marine Manufacturers Association (NMMA) – TC W-III



EnviroLogic® 100

Biodegradable

Vegetable Oil Hydraulic Fluid Series

- Hydrostatic (hydraulically actuated) mowers.
- General duty hydraulic applications.
- Drawbridges, piledrivers, cranes.
- Irrigation drip pump.
- Hydraulic lifts, lift truck, waste haulers, truck compacters.
- All equipment near water.



Key Benefits:

- Biodegradable and non-toxic so in the event of a leak or spill will have reduced environmental impact.
- Outstanding lubricity and lower operating temperatures will provide longer equipment life and reduced downtime.

Meets Requirements Of:

Denison, Vickers, Eaton, Parker, Rexroth Sundstrand, Poclain.
Available in ISO 22, 32, 46, and 68, 100



EnviroLogic® 3000 Synthetic Biodegradable Series

Application:

- Ultra High Temperature >400 degrees
- Premium performance / cost effective
- Virtually all hydraulic systems.

Key Benefits:

- Biodegradable, non-toxic.
- Enhanced Lubricity
- Long Useful Life (“fill for life”)

Meets Requirements Of:

Denison, Vickers, Sundstrand, Rexroth, Poclain, Cincinnati
Milacron, Parker, Gates, Linde

Available in ISO 22, 32, 46, and 68, and 100.



EnviroLogic® 700

Biodegradable Universal Tractor Fluid

Key application:

Tractor transmission, hydraulics, wet brakes

Key Benefit:

- Excellent performance will protect equipment better.
- Biodegradable so in the event of spill or leak will not kill grass.

Testing:

- John Deere, Allison, Caterpillar, Ford, New Holland, Case IH
- Suitable for tractor transmissions, hydraulics and brake applications.



EnviroLogic BD 100

Soy-based Diesel Fuel / Fuel Enhancers

- *Application:*
- All diesel powered equipment, on and off highway trucks, diesel powered impact hammers, farm tractors, busses, generators
- *Key Benefits:*
- Every 450 gallons is 1 EPACT credit
- Ready replacement, compatible with all diesel powered equipment *
- 100% American grown soybeans
- Non-toxic and readily biodegradable
- Undetectable levels of sulfur, no aromatic hydrocarbon
- High flash point > 300° F
- Can be used at 100% or less; works for B20 diesel
- Pleasant aroma

Bio FHD-30

Biobased, Multifunctional detergent/dispersant diesel fuel treatment that is suitable for use in conventional diesel fuel as well as levels of biodiesel B-5 through B-100.

Meets the federal biobased guidelines for Fuel Additive Category as mandated by the “Farm Security and Rural Investment Act of 2002” (the Farm Bill).

Performance Claims:

- Improve lubricity
- Reduces wear caused by low sulfur diesel fuel
- Clean up and keep clean injectors
- Improve fuel economy
- Reduce emissions
- Improve storage stability
- Improve water tolerance

EnviroLogic® 500

Dust Control Concentrate

Key application:

Dusty conditions

Key benefits:

- Low environmental impact and excellent dust suppression.
- Can be used where alternatives are either environmentally unacceptable (oil) or ineffective (water).

Field testing :

Ongoing

Application:

Approximately four (4) parts water, one (1) part concentrate.

Dust and its undesirable results are apparent to everyone. Most dust control methods are either unsuitable for the environment or are ineffective. EnviroLogic® 500 is a biodegradable and non toxic dust suppressant that works. The specialty performance additives safely coat dust particles and prevent them from becoming airborne. The natural ester technology allows biodegradation keeping waterways and greens clean.



EnviroLogic 200 Gear Oil



- Propellers
- Thrusters
- Winches
- Cranes



Compatibility

- Some fluids are compatible with petroleum fluids.
- Mixing of biodegradable fluids with petroleum based fluids will reduce environmental characteristics.
- Biodegradable flushing is recommended but not required (typical residual is 15%-20% without flush)

Conclusions

- Making the determination to change to bio lubricants one should consider many factors
- A bio oil can be more expensive initially but can save money in the long term
- Bio oils have been proven in the field and can perform as well as petroleum

Inherently Biodegradable Does **Not Readily** Biodegrade

Strengths

- Oxidative Stability
- Low Toxicity
- Good performance
- Good Seal
Compatibility
- Low Cost

Weaknesses

- Not Biodegradable
- Expensive for
petroleum

Conventional Vegetable Fluids

HETG

Strengths

- Lubricity
- Cleanliness
- Environmental
- Biodegradable
- Low Cost (among biodegradables)

Weaknesses

- Oxidative Stability
 - Temperature limitations
 - Life expectancy
- Hydrolytic Stability
- Care must be taken

Enhanced Vegetable Fluids HETG+

Strengths

- Lubricity
- Cleanliness
- Environmental
- Biodegradable
- Low Cost (among biodegradables)
- Renewable

Weaknesses

- Finite life expectancy

Polyglycol Synthetic (PAG)

Strengths














- Fire Resistant
- Broad Temperature Range

Weaknesses

- High Cost
- Not Compatible with Conventional Seals or Filters
- Not Compatible with Petroleum or Vegetable
- Oxidative Stability
- Absorbs Water (creates rust and acid)

Figure 1

Polyurethane Seal Immersion Testing (Parker Components)
500 hrs; 100° C

Fluid	Shaft Face Plate O-Ring (TTL ID #)	O-Ring A (TTL ID #)	O-Ring B (TTL ID #)
New Seals			
Greens Care 46 (current formula)	 #129-39	 #129-38	 #129-40
Dexron III ATF	 #129-24	 #129-23	 #129-25
Shell Naturelle	 #129-34	 #129-32	 #129-36
Competitive PAG		 #137-389 (240 hours)	 #137-389A (240 hours)

TRT/PLSIT

New Seal

Bio Poly Olefin
EL 3046

ATF

Syn Ester

PAG

Synthetic Esters (HEES)

Strengths

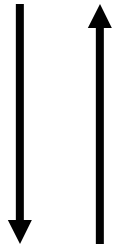
- Oxidative Stability
- Biodegradable

Weaknesses

- Hydrolytic Stability
 - “unzips” with water
- Acid formation
- Seal Deterioration
- Temperature Limitation
- Expensive

Ester Chemistry

Vegetable Oil + Alcohol + Acid



Synthetic Ester + Water + Heat

Bio-polyolefin Synthetic (HEPR)

Strengths

- Extended Life
- Low Cost (for life of fluid)
- Oxidative Stability
- Low Toxicity
- Good Seal Compatibility
- Broad Temperature Range

Weaknesses

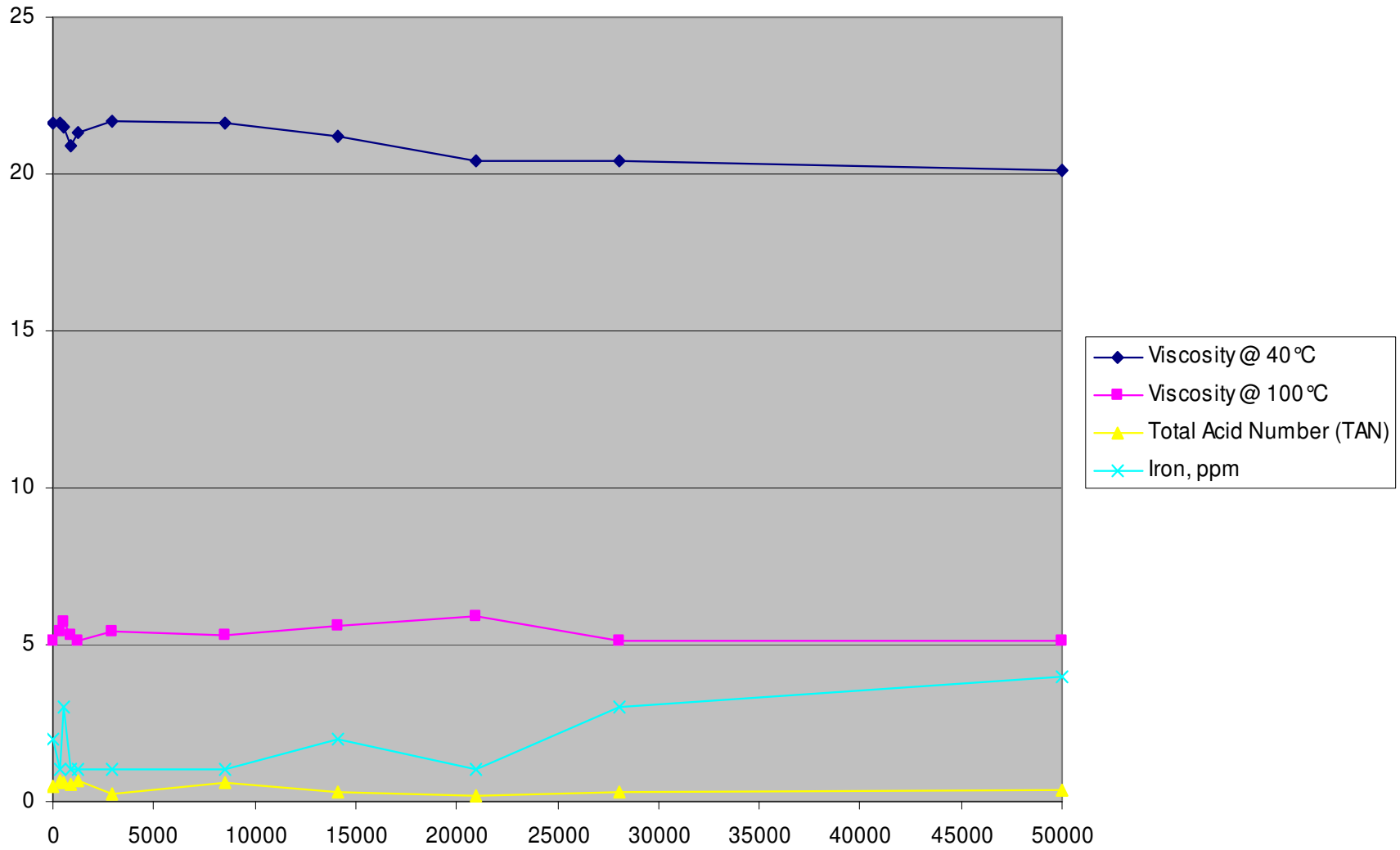
- High Cost (compared to non-synthetic)

Utility Truck Field Trial

- Northeast Utilities
- Trouble Truck
- Converted 01/2004
- PTO hours – 6,000+
- Oil in unit for over 55,000 hours!



Northeast Utilities Field Performance



In-Service Hours



TERRESOLVE
Technologies Ltd.

Bio-Based,
Biodegradable Lubricants

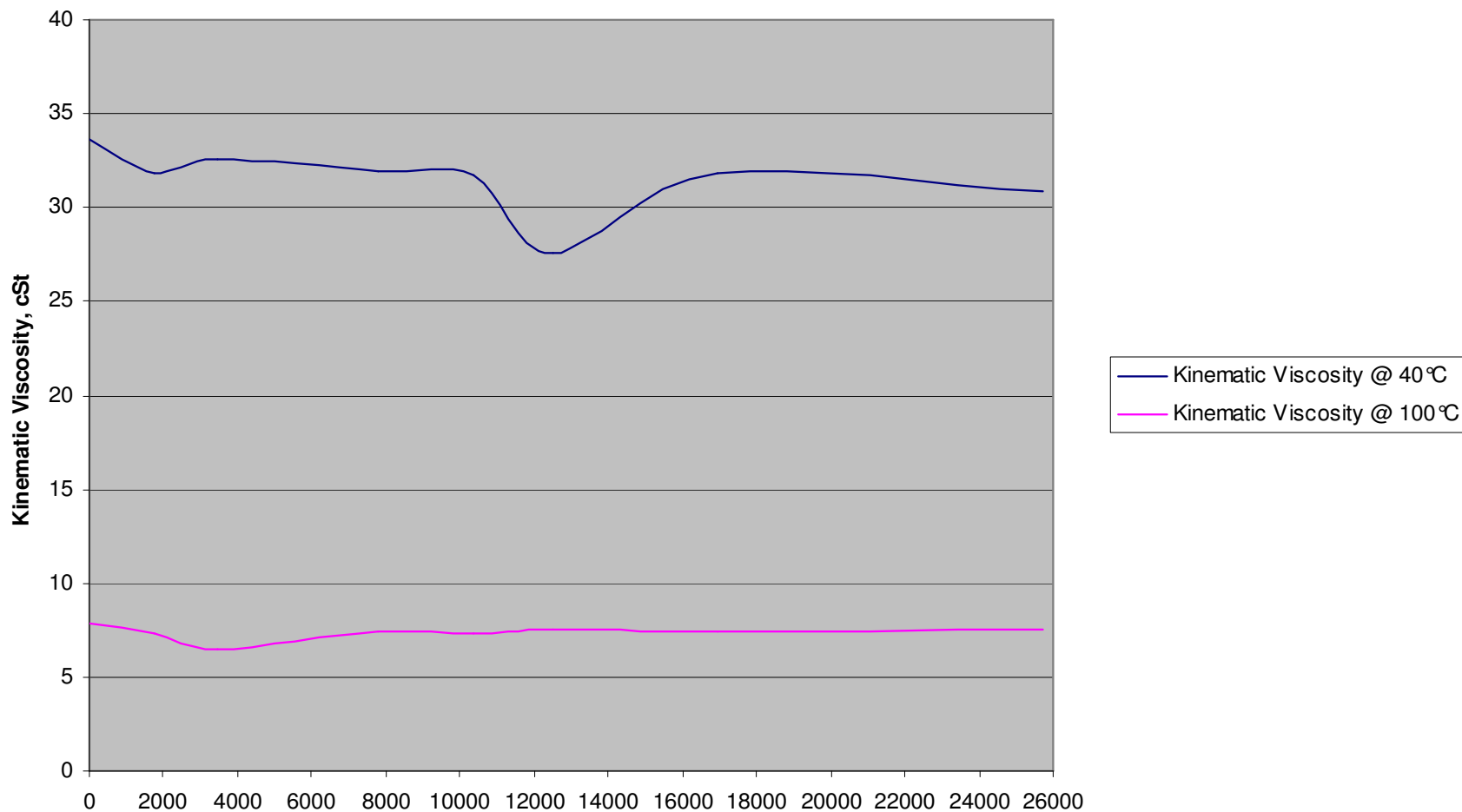
Wind Turbine Field Trial



- ISO 32 Biobased Hydraulic Fluid
- Started May 2007
- 26,000 in-service hours
- Vestas V27 225 KW Turbine
- Parker Hydraulics

Viscosity

Viscosity



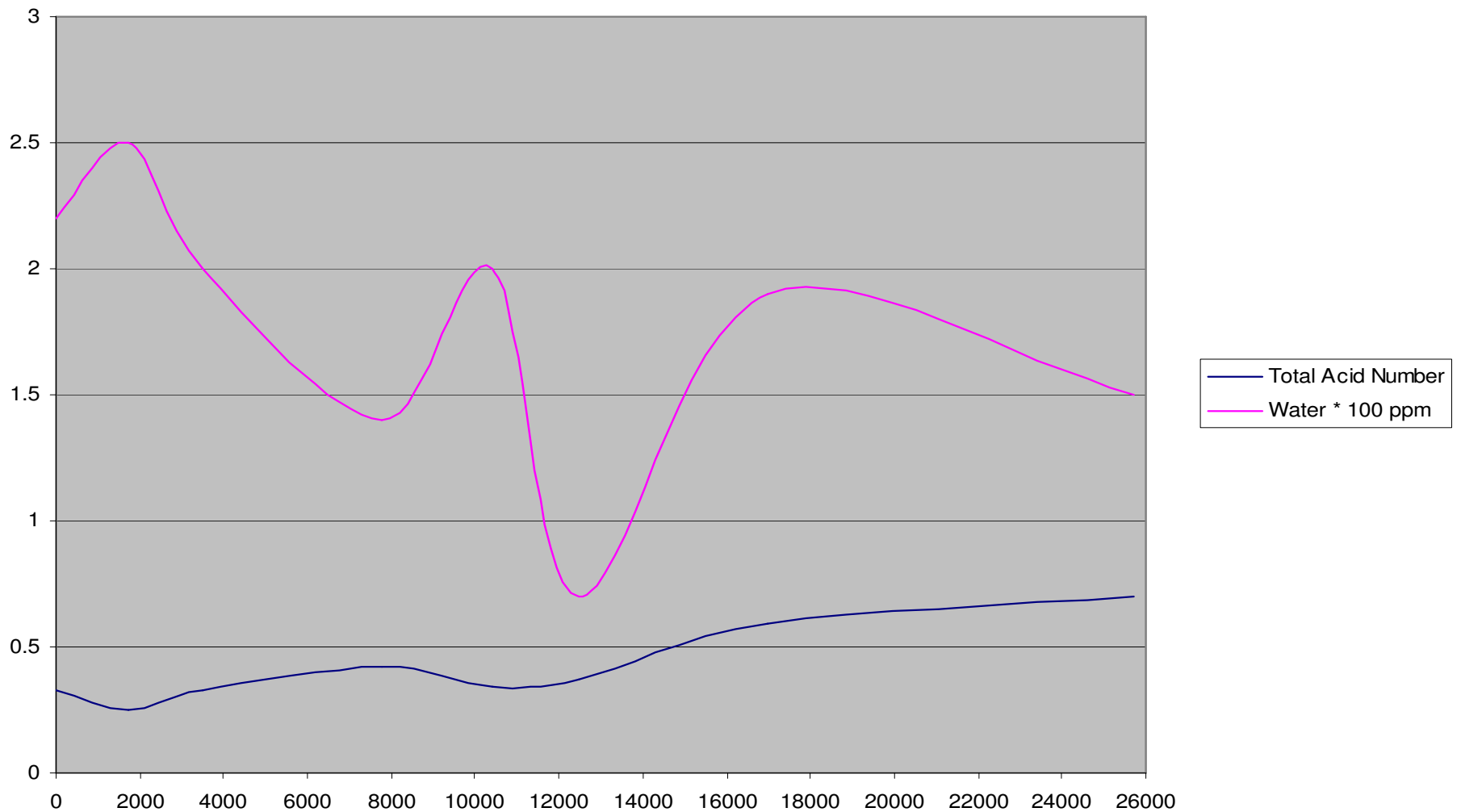
Hours In Service



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Bio-Based,
Biodegradable Lubricants

Total Acid Number - Water



Elements

Elementals

